# The Role of Tax Evasion, Liquidity Preference and Borrower Sophistication in Strategic Default*

Nikolaos Artavanis[1] and Ioannis Spyridopoulos[2]

[1]University of Massachusetts Amherst, Isenberg School of Management
[2]American University, Kogod School of Business

February 14, 2018

*We are thankful to a Greek bank for the provision of data and Stathis Potamitis for excellent legal advice. We are grateful for constructive comments from Amit Seru, Daniel Wolfenzon (discussant), Paul Willen (discussant), George Panos and seminar participants at FMA Europe, European FMA, CEPR European Summer Symposium in Financial Markets, FMA, CELS meetings, and the Atlanta FRB Real Estate conference, the University of Massachusetts Amherst, American University, Virginia Tech, ICADE-Universidad Pontificia Comillas, the University of Rhode Island, and the University of Glasgow. We welcome comments and suggestions. All errors are our own. A previous version of this paper was circulated as "Foreclosure Moratorium and Strategic Default". E-mail addresses: nartavanis@isenberg.umass.edu (N. Artavanis), ispyrido@american.edu (I. Spyridopoulos)

# The Role of Tax Evasion, Liquidity Preference and Borrower Sophistication in Strategic Default

**Abstract**

We exploit the introduction of a moratorium and a new personal bankruptcy process that protect primary residences from foreclosure, in Greece, to identify customers, who default on their mortgages despite ability to pay. Using proprietary data from a large bank, we conservatively estimate that 28% of defaults in primary residence mortgages are strategic, which corresponds to over 5 billion euros in non-performing loans for the Greek banking system. Our findings suggest that prior engagement in moral hazard behavior, in the form of tax evasion, the existence of adverse liquidity shocks, and borrower's level of financial and legal sophistication are significantly and positively related to strategic default behavior.

*Keywords*: Strategic default, Foreclosure moratorium, Mortgage default, Moral hazard.

*JEL classification*: G21, D10, K35.

# I. Introduction

Moral hazard and adverse selection problems permeate financial markets and complicate the effectiveness of government policy making (Stiglitz and Weiss (1981)). For credit markets, in particular, moral hazard behavior from the borrowers' side, in the form of strategic default, not only increases the cost of credit, but it may threaten the very existence of the market itself, as shown by Akerlof (1970). Even though stategic default has received increased attention lately in the context of mortgage markets, due to the recent U.S. crisis, (Guiso et al. (2013), Mayer et al. (2014), Gerardi et al. (2017), Bhutta et al. (2017)), strategic behavior exists in almost every credit market.[1] In this paper, we exploit a unique set of regulatory changes in Greece that allow us to identify and study the characteristics of individuals, who default on their mortgage payments despite their ability to pay.

As a response to the ongoing financial crisis in Greece, legislators introduced a set of measures, in June 2010, to provide relief to over-indebted households. Specifically, the government introduced a personal bankruptcy law that excluded primary residences from liquidation. This process required homeowners to undergo a multi-stage application and auditing process to prove over-indebtedness and inability to service their loans. Concurrently, the government implemented an almost universal foreclosure moratorium, preventing banks from foreclosing primary homes. The two provisions were legislated independently and both protected primary residences, a key element we exploit to identify strategic default behavior.

Our identification criterion relies on the observed choice of borrowers between the bankruptcy process and the foreclosure moratorium as a mean to protect their primary residences. We argue that for mortgagors, who are truly unable to service their debt there is a dominant strategy; to default and apply for personal bankruptcy process. The reason is that, on top of protecting their primary home, they become eligible for a generous, permanent debt-haircut that can reach up to 80-90%. On the other hand, borrowers with ability to pay would stray

[1] For example, strategic default has been examined in the context of corporate debt (Giroud et al. (2012)), unsecured debt (Gross and Souleles (2002)), and student loans (Yannelis (2016)). In 2008, Ecuador selectively defaulted on some of its issues, becoming the first case of strategic default on sovereign debt.

away from the debt discharge process to avoid liquidation and disclosure costs, associated with their additional wealth, and instead would choose to default passively, protecting their primary residence through the foreclosure moratorium. Therefore, the homeowner's *revealed* preference for personal bankruptcy allows us to identify non-strategic defaulters, who default and apply, from strategic defaulters, who default without applying for personal bankruptcy.

Previous contributions in the mortgage strategic default literature assess borrowers' ability to pay by relying on survey responses or observable customer and loan characteristics. In contrast, our criterion is based on the behavior of the agent with superior information regarding ability to pay; *the borrower*. Specifically, we let strategic defaulters self-identify themselves based on the preference towards the debt discharge process, which requires the disclosure and liquidation of additional (to the primary residence) wealth in return for a generous debt relief.

We apply our identification criterion to a large representative sample of borrowers to estimate the incidence of strategic default in the mortgage market. We conservatively estimate that, until the end of 2013, at least 28% of defaults were strategic. This rate aggregates to over 5 billion euros in non-performing loans across the Greek banking system. This cost was largely moved to the public through recapitalizations that increased government debt and depleted state holdings in Greek banks.

Consistent with previous studies, we find that delinquency is more likely for people with lower credit scores, who borrow larger amounts, and loans with higher combined loan-to-value ratios (Campbell and Dietrich (1983), Elul et al. (2010), Demyanyk and Van Hemert (2011)). In contrast, strategic defaulters have higher credit scores and reported income, and mortgages with lower CLTVs compared to non-strategic defaulters, indicating a relatively higher ability to pay their debt obligations. We find significant heterogeneity in the incidence of strategic default across different groups of borrowers; for example, self-employed professionals exhibit higher propensity to exhibit strategic behavior, while pensioners and single-parent families are significantly less likely to default deliberately.

Next, we focus on factors that can explain the significant heterogeneity in the incidence of strategic defaults across homeowners we observe. Our results indicate that self-employed professionals consistently exhibit high propensity to default strategically. We relate this finding to another prominent characteristic of self-employment status; tax evasion (Kleven et al. (2011), Artavanis et al. (2016)). Following the methodology of Artavanis et al. (2016), we estimate tax evasion multipliers among self-employed professionals and find evidence that evading activity is significantly and positively related to the probability of strategic default; for every 9,000 euros in unreported income, the probability that a default is strategic increases by 3.7%. These results suggest that individuals engaging in one type of moral hazard (tax-evasion) are more likely to exhibit moral hazard behavior of a different type (strategic default) in the future.

Additionally, we find that liquidity preference can motivate strategic behavior, as borrowers may default deliberately, in order to retain desired levels of liquidity (Cohen-Cole and Morse (2010)). In our setting, the moratorium prevents foreclosures, and as a result a defaulter keeps the house at least for the duration of the provision. As a result, the negative equity condition becomes non-binding, while the forgone mortgage payment is realized as a positive liquidity shock, since the borrower does not have to seek additional housing services. We test the liquidity preference hypothesis, indirectly, by focusing on a group that experienced substantial adverse liquidity shocks. We examine high income pensioners, who realized pension cuts exceeding 30% during our sample period (Tinios (2016)), while low income pensioners were largely protected by austerity measures. This provides a homogeneous group of treated (high income) and control (low income) pensioners. Consistent with the liquidity preference hypothesis, we find significantly larger concentration of strategic defaulters among high income pensioners, suggesting an effort to offset the realized, adverse income shocks by foregoing mortgage payments.

Finally, we find that professionals in the industries of law and finance, even though they have low overall default rates, they exhibit among the highest rates of strategic default—47% and 41%, respectively. We attribute this result to the level of financial and legal sophistica-

tion of these professionals, which allows them to better understand the ramifications of the introduced legislation and use more efficiently these provisions to their benefit. We further show that these groups appear to process different type of information, since the finance professionals react significantly more aggressively to the existence of negative equity, while law professionals exhibit the same propensity to default strategically regardless of the state of the loan.

Our study contributes to the growing literature on strategic default in mortgage markets. Guiso et al. (2013), using a survey method, estimate that 26%-35% of defaults are strategic and highlight behavioral factors that contribute to the phenomenon. Mayer et al. (2014) show that a favorable legal settlement was resulted to a significant increase in default rates, as solvent borrowers attempted to benefit from the provisions. Gerardi et al. (2017)) find that 38% of defaults in their sample are strategic, while 80% of borrowers that appear not having ability to pay, continue to make their mortgage payments. Finally, Bhutta et al. (2017) examine defaults of high creditworthiness customers, and argue that implied foreclosure costs are substantial, which can prevent strategic default on mortgages that are not deep underwater.

The greatest challenge of studying strategic default remains its identification, and more specifically, estimating whether a borrower that defaults has the ability to pay. On this front, our approach to identify strategic defaulters is novel because it is based on observing the behavior of the borrower, who posesses superior information regarding the ability to pay in our setting. Additionally, our criterion is free of self-reporting biases that may hinder survey methods (Hurst et al. (2014)), or limitations of financial and banking data in uncovering borrowers' true ability to pay (Guiso et al. (2013)). Furthermore, since we do not condition on borrower or loan characteristics (i.e. credit scores, CLTVs) to identify strategic default, we can examine these characteristics in our analysis (see Guiso et al. (2013)).

This paper also contributes to the literature on the determinants of strategic default. In addition to borrower and loan characteristics, our results suggest that prior engagement in moral hazard and borrower sophistication play an important role in exhibiting strategic

behavior. Our findings also highlight the importance of liquidity preference on strategic behavior that has been documented even in non-recourse settings (Cohen-Cole and Morse (2010)), where the negative equity hypothesis is dominant. Our setting, which temporarily mutes the negative equity channel, provides a unique opportunity to examine in full extent the effect of liquidity preference, whose spill-over effects can be pivotal in evaluating social wealthfare outcomes from strategic behavior, as noted by Mian and Sufi (2014).

Finally, our study highlights the role of collateral in enforcing contracts on repayments, which under normal cicrumstances it is difficult to establish, due the lack of a testable counter-factual.[2] Here, the moratorium serves as a policy shock that invalidates unexpectedly, previously imposed, covenants on foreclosures for a prolonged period of time. The small literature around the scarce cases of moratoria focuses on their effect on the supply (Alston (1984), Pence (2006)); more notably, Morse and Tsoutsoura (2013) show that the foreclosure moratorium in Greece was followed by a sharp decrease in new loans. We compliment these findings, by examining the effect of the moratorium on repayment patterns and moral hazard behavior by borrowers.

The remainder of the study is organized as follows. The next section provides details for the legal framework and the definitions of strategic and liquidity defaulters. Section III describes our data. Section IV presents our empirical results regarding the incidence, the distribution of strategic default and factors associated with strategic behavior. Section V concludes the study.

[2]This is particularly true for mortgages, where collateral is internal. But even in loans types, where collateral is external, ex-ante differences on collateral covenants are subject to differential treatment by lenders.

# II. Legal Framework

## A. Legal Framework for Personal Bankruptcy and Foreclosure Moratoria

Before 2010, Greece did not have any personal default framework for individuals.[3] In June of 2010, the Greek Parliament passed new provisions that aimed to provide relief to over-indebted households that could not service their debts, due to the ongoing financial crisis. Law N.3869/2010, also known as the law for "over-indebted households" or the "Katseli law", introduced a *primary residence mortgage moratorium* and a *debt discharge process*.

The law originally deferred foreclosures of primary residences for six months, but was subsequently extended without any change until the end of 2013.[4] The electorate provided strong support for politicians to protect mortgagors, similarly to a Bolton and Rosenthal (2002) setting, where unanticipated political intervention can improve efficiency by completing incomplete debt contracts and preventing negative spill-over effects from a large number of foreclosures. Not surprisingly, the aforementioned regulation received the unanimous support of all political parties in Greece, creating expectations that the status quo would be maintained unchanged for the foreseeable future.

The new set of regulations provide *dual protection* for primary residences, a feature that we exploit to identify strategic default. First, the Greek government imposed a foreclosure moratorium on primary residences with objective value below 300,000 euros.[5] In practice, the moratorium protected the vast majority of primary residences from foreclosure, making the effect of the provision almost universal. Figure 1 plots the objective values of primary

[3] The ability to default was only available to commercials with N.3855/2007. See Vallender et al. (2013) for more details on personal debt charge provisions in Greece and other European countries.

[4] The protection of the primary residence prescribed in N.3869/2010 was extended with N.3886/2011, N.4047/2012, and N.4128/2013. Starting from 1/1/2014, N.4224/2013 imposed additional criteria on the objective value of the primary residence and income. In 2015, the aforementioned criteria became significantly stricter, but continued to covered two thirds of the existing mortgages).

[5] Objective values correspond to presumed values used by tax authorities to estimate tax liabilities, and at the time of the implementation were significantly lower than market values. The 300,000 euros threshold applied to for single individuals and increased up to 450,000 euros for couples with 3 or more children.

dwellings in our sample; the median objective value is 71,000 euros, while 98.7% of dwellings in our sample fall below the lowest inclusion threshold.

Second, the law for over-indebted households (N.3869/2010) introduced a personal bankruptcy procedure that *excluded primary residences from liquidation*, using the exact same inclusion criteria with the moratorium. The debt discharge process included the following three stages:

- *Stage 1 (Application)*: The borrower applies for personal bankruptcy protection resulting to an automatic stay of any actions from creditors. From the time of the application mortgages accrue interest at the non-delinquency rate.

- *Stage 2 (Out-of-Court Settlement)*: The borrower provides to creditors a list of eligible debt obligations to be settled, a comprehensive report that discloses her current financial state (financial/real assets and income), along with a proposed repayment plan. The settlement is successful if the two parties agree on the repayment plan within three months.

- *Stage 3 (In-Court Settlement)*: If the out-of-court settlement is unsuccessful the case is deferred to the court. The court orders for the liquidation of the borrower's assets—excluding the primary residence— and then sets a monthly payment for the next four years at a level that allows the borrower to "maintain decent living standards". The court eliminates the residual debt and the borrower receives a *debt haircut*.

In practice, this framework proved to be incomplete, dysfunctional, and prone to abuse (Paulus et al. (2015)), due to the inefficiencies of the Greek judicial system.[6] The provisions applied only to private debt, thus failing to provide full discharge for a wide range of other obligations, mainly towards the government (taxes, social security). Additionally, the vagueness of the law allowed for subjective interpretation that usually favored the borrower.

[6] "European judicial systems: Efficiency and quality of Justice" [European Comission (2014)].

## B. Identification of Strategic Default

Strategic default is the deliberate decision of a borrower to become delinquent, despite ability to service her debt (Mian and Sufi (2009)). The greatest challenge in identifying strategic defaulters is assessing their "ability to pay", especially since they have the incetive to camouflage as borrowers who cannot serve their debt obligations (Guiso et al. (2013)). Thus, detecting such behavior presupposes that the researcher has a comprehensive view of the borrower's financial state. However, in reality this information is not attainable, as individuals may hold hidden assets or have informal income.

The past literature has used different methods to evaluate a borrower's "ability to pay", each having its own merits and limitations. The first method includes surveys, where the strategic default behavior is detected through a set of questions. Surveys have the advantage of allowing the examination of different scenarios for the same subject (Guiso et al. (2013)), however they are often subject to self-reporting biases (Hurst et al. (2014)), especially when questions refer to hypothetical scenarios rather than realized actions. A second approach involved the use of financial data to determine whether the borrower can afford debt payments. These financial variables include measures of liquidity (Gerardi et al. (2017)), credit scores (Goodstein et al. (2017)), and repayment patterns (Cohen-Cole and Morse (2010)). This approach is more direct, as it aims to provide tangible evidence of ability to pay, but it can underestimate the effect if debtors have hidden assets or income, not reflected in formal datasets.[7]. A third way to document strategic default behavior is to examine borrowers' response to policy changes or modification plans (Mayer et al. (2014), Yannelis (2016))). This approach provides strong evidence regarding the incidence of the phenomenon, but typically cannot identify strategic defaulters without the use of an additional criterion.

Our methodology is closer to the last approach with the difference that it allows for the identification of strategic and not strategic defaulters in our sample. Additionally, our identificaction method has two major advantages with respect to approaches used in the

[7]For example, Gerardi et al. (2017) find that 80% of "can't pay" households continue to serve their mortgages, which implies that these borrowers have access to income streams that are not reflected on formal financial datasets.

past. First, it is based on the behavior of the entity with superior information regarding ability to pay; the borrower. Therefore, it can detect strategic behavior, even in cases that formal data cannot capture the comprehensive financial state of the mortgagor. Second, it does not condition on any borrower or loan characteristic, thus it allows us to examine the distribution of these variables without any prior restrictions.

We present how our criterion works, by formulating it as a decision tree strategy game (Figure 1). Before the implementation of the law, in the presence of positive foreclosure costs,[8] default only if the mortgage is underwater and the mortgagor has inability to pay (see Appendix). For a mortgagor with ability to pay, default in never optimal, because Greece is a recourse state, thus borrowers are responsible for the entire amount of the loan (see Ghent and Kudlyak (2011)), and delinquency involves additional foreclosure costs.

The introduction of the foreclosure moratorium and the debt discharge process prevents foreclosure costs and creates three possible states for borrowers, as shown in Figure 1.b. If borrowers "default and apply" they are eligible for a debt haircut, but at the same time subject to liquidation and disclosure costs, all of which depend on their ability to pay. On the other hand, "default without applying", incurs penalties from delinquency, but provides potential benefits, which we model in the form of an expected general debt haircut in the future.

Using backwards induction, we show that borrowers with low ability to pay (low income and wealth), will strictly prefer to "default and apply" for bankruptcy. The reason is that these mortgagors are eligible for a high debt haircut, while subject to low liquidation and disclosure costs. The exact opposite holds in the case of borrowers with high ability to pay; the debt haircut is low, while liquidation and disclosure costs are high. Therefore, these borrowers will choose to remain current on their debt obligations or "default without applying", depending on whether expected benefits of the latter exceed the respective costs (see Appendix).

Following this rationale, we identify strategic and non-strategic defaulters, as follows:

[8] Foreclosure cost can be substantial; Bhutta et al. (2017) estimate that average foreclosure costs for US mortgages exceed $50,000.

- *Strategic Defaulters*: Primary residence mortgagors, who become delinquent, but do not apply for inclusion to the debt discharge provisions of N.3869/2010.

- *Non-Strategic Defaulters*: Primary residence mortgagors, who become delinquent, and apply for inclusion to the debt discharge provisions of N.3869/2010.

The intuition behind our criterion is that individuals with true inability can only gain from the bankruptcy process, because they protect their primary residence from liquidation and, in addition, they become eligible for a large, permanent debt haircut. On the other hand, debtors who choose to passively default on mortgage payments without applying for debt discharge, signal ability to pay either in the form of additional assets that they wish to protect from liquidation or sufficient income that prevents eligible for a debt haircut.

## III. Data & Samples

Our dataset includes the universe of primary residence mortgages from a large Greek bank. We focus only on primary residence mortgages, in order to exploit the overlap of protection for the primary home by the foreclosure moratorium and the personal bankruptcy process. We also restrict our sample to mortgages originated after 2006, for which both the application and the performance files are available. We exclude any loans that were made after June 2010 (post-legislation). These restrictions yield a sample that is representative of our entire mortgage pool, since the household credit boom occurred mainly post-2004, as a result of the financial liberalization of the Greek banking system and the introduction of euro (see Haliassos et al. (2016)). Our sample includes tens of thousands of mortgages.

From the application files, we obtain important information for loan terms (amount approved, monthly installment, interest rate, interest rate type, maturity, existence of consignors) and customer characteristics (credit score, reported personal and total income, age, occupation, marital status, number of children, and education level). For each borrower, we are provided with the total debt outstanding towards the bank and other financial institutions, which allows us to calculate the total bank debt at the time of application. We also

observe the initial loan-to-value (LTV) and combined loan-to-value (CLTV) ratios, and the initial market value of the property.

From performance files, we observe monthly repayment patterns and the exact time a borrower becomes delinquent. Additionally, the these files track changes in market values of dwellings, calculated based on a detailed, annually updated real-estate index, current LTV and CLTV ratios. We compliment these data with hand-collected objective values for each dwelling, to determine eligibility for the foreclosure moratorium. Finally, if the borrower applies for the debt discharge procedure, we use a separate dataset that depicts the exact timing of entrance in each of the 3 stages of the process.

Our sample period is from 2007 to 2013. We define defaulters as borrowers that are delinquent for 180 days in delay (t+6 rule) or become delinquent on a previously restructured loan. Following the specification of the previous section, liquidity defaulters are identified as the ones that have defaulted before the implantation of law N.3869/2010, or have become delinquent after, but applied for inclusion to its provisions, up to six months past our sample period (June 2014).[9]

In order to obtain a sample that is eligible for both provisions, we make the following adjustments:

1. Since law N.3869/2010 applies only to non-commercials, we exclude commercials.[10]

2. We exclude mortgages on primary residences with objective values above the threshold, based on the demographics of the borrower (i.e. marital status, children) at the time of contracting.

[9] In an additional attempt to be conservative, we define liquidity defaulters as delinquent borrowers who apply for the debt discharge process *anytime* until June 2014, regardless of the time of default. This entails the risk that strategic defaulters might apply in expectation that the law provision might change. For example, the change of the foreclosure moratorium threshold in 2016 resulted in the submission of over 200,000 debt discharge applications during the last three months of 2015. We examine the timing of applications, and we find that the this is not a concern for our sample period (2010-2013).

[10] For the purpose of the law, commercials are defined as individuals, who profit from commercial activity. This definition excludes self-employed individuals, as doctors, engineers, lawyers, and low-scale commercials that are mainly compensated for their personal labor. We define commercials based on their detailed occupation description for professionals that report more than 50,000 euros in annual income. We also use an alternative threshold of 30,000 euros, with no significant changes in our main results.

3. We require that the total debt obligations towards our bank exceed the 50% of the current market value of the primary residence, in order to ensure that a significant haircut is possible, if the borrower is eligible.[11]

We construct our main sample by applying the aforementioned filters. It should be noted that the third adjustment makes our estimates on strategic default more conservative for two reasons. First, judicial practice suggests that ruling for additional payments is quite uncommon. Second, our proxy for the debt exposure of the borrower is imperfect; our measure uses the total bank debt of the borrower at the time of contracting. Hence, it underestimates eligible debt obligations, if the borrower has personal, non-bank debt or has accumulated additional debt since the application date.

Table I presents summary statistics for our main sample, after applying the aforementioned conditions. On the law implementation date (July 2010), our average mortgage exceeds 150,000 euros with average interest rate 4% and maturity 25 years. Commercial values are significantly higher than objective values, and the mean initial CLTV in our sample is 0.62. Our average borrower is 51 years old, reports personal (total) income around 15,000 (30,000) euros and typically has a cosigner or a guarantor.

# IV. Empirical Results

## A. Incidence and Distribution of Strategic Default

### A1. Foreclosure Moratorium and Defaults

The Greek banking system experienced an unprecedented period of high delinquency rates across all credit products during the recent financial crisis (Haliassos et al. (2016)). Given than residential mortgages constitute a significant portion of the total bank portfo-

[11] There is a covenant in the law that gives to the court *the right* to rule for additional payments up to 85% of the current market value of the house, in the event that the primary residence is excluded from liquidation. Our imposed threshold of 50% corresponds to the present value of the maximum amount the court may rule to be paid in a period of 20 years with a discount rate of 5%.

lio,[12] it is important to assess whether the increased mortgage defaults rates were related, even partially, to the introduction of the foreclosure moratorium in 2010.

Figure 3 plots default rates for the primary and secondary residence mortgage portfolio for loans contracted after 2006 by our bank. Default rates increase dramatically in the post-crisis period, exceeding 35% for the primary and 23% for the secondary mortgage portfolio by the end of 2013.[13] To put these numbers in perspective, the delinquency and foreclosure rates in the U.S. market reached 11.5% (FRB of St.Louis) and 4.6%, respecitively (Frame (2010)). More importantly, the slopes of both curves become steeper six months after the introduction of the moratorium, as mortgage delinquencies require a 180-day payment delay, consistent with the findings of Morse and Tsoutsoura (2013) and Dendramis et al. (2017).

Since the Greek economy was in a deep recession during our sample period, we cannot fully attribute the increase in mortgage defaults to the new regulations. However, the increase in the difference of delinquency rates between the two portfolios suggests that the primary residence foreclosure moratorium had an important impact.

Even though suggestive, we do not draw causal inferences from Figure 3, for two reasons. First, secondary residence mortgages also received (a more limited) protection by a general foreclosure moratorium, also imposed in June 2010 (N.3858/2010). This provision prevented any foreclosure for total debt below 200,000 euros. This threshold included non-bank debt, for which the registry does not have information, and therefore we cannot access borrower eligibility, in order to implement a regression discontinuity approach. Second, there are wealth effect considerations; borrowers that can afford a secondary residence may be wealthier, which in turn can affect the probability of default. Instead, we focus our analysis on primary homes, for which the primary residence foreclosure moratorium is dominant, and detect strategic defaults by observing the behavior of borrowers as described in section II.B.

[12] According to the Bank of Greece, the exposure of Greek banks in mortgages in December 2013 was 70,69 billion euros, which represents 30% of total bank credit.

[13] Default rates in Figure 3 refer to the total sample and at the lien level. The 41.5% defult rate reported in the next section refers to our main sample at the customer level.

### A2. Incidence of Strategic Default

By the end of 2013, default rates in our main sample for primary residences reach 41.5% at the borrower level. As noted previously, such unprecedented rates of default are attributed to both adverse economic conditions and strategic behavior. Applying our identification criterion, we conservatively estimate that at least 28.4% of these defaults were deliberate; borrowers became delinquent without applying for the debt discharge process, indicating the existence of additional assets or sufficient income. This percentage corresponds to 11.8% of the total borrowers in our sample.

It is important to emphasize that our estimates constitute a lower bound for the incidence of strategic default, for an number of reasons. First, our identification criterion is designed to be conservative; we treat all defaults prior the moratorium implementation date as non-strategic, and classify delinquencies as non-strategic, anytime until the end of our sample period. Also, we can not rule out the existence of loopholes that enable mortgagors to apply for debt discharge. For example, a borrower may transfer assets to a third person, before applying for debt discharge. However, these practices entail a certain amount of risk, when the case is examined in a court of law.

Our results are comparable to findings for strategic default incidence in the prior literature. Guiso et al. (2013) estimate, through a survey, that 36% of delinquencies were strategic by 2010 in the U.S. mortgage market, while Gerardi et al. (2017) find that respective rate is 38%, accessing ability to pay from liquidity measures. Of course default rates during the U.S. mortgage crisis were significantly lower compared to the Greek crisis, as mentioned previously. However, proportionally the incidence of strategic default is large in both settings.

Strategic behavior had a sizable, adverse effect on the financial health of the Greek banking system. The Bank of Greece reports 70.6 billion euros in outstanding mortgages, as of December 2013. Assuming that 60-70% of this portfolio refers to primary homes,[14] our

[14]The Bank of Greece does not provide any classification of mortgages by residence type (primary vs secondary). Instead, we surveyed bank managers of Greek systemic banks, and used their lower bound estimates as benchmarks.

estimates aggregate between 5 and 6 billion euros in non-performing loans attributable to strategic default, from the primary residence portfolio only. This cost was primarly moved to the public through recapitalizations that increased government debt and depleted state's bank holdings. For example, the second recapitalization, in spring 2014, amounted to 8.3 billion euros (Haliassos et al. (2016)), a figure comparable to our estimated losses from strategic default in the mortgage portfolio.

### A3. Loan and Borrower Characteristics

One of the advantages of our identification criterion is that it does not rely on borrower or loan characteristics, but on the observed behavior of borrowers to assess ability to pay. This novel feature allows us to examine the distribution of these characteristics in our analysis, which would not be possible otherwise, due to correlation effects. For example, identifying strategic defaulters on the basis of their high credit score, prevents any reliable inference on their income, if the two variables are highly correlated.

Table II reports univariate differences on loan and borrower characteristics as of July 2010. Columns (1)-(3) present mean values for characteristics of defaulters and non-defaulters. Defaulters have significantly higher loan amounts and CLTVs, but lower initial reported income and credit scores, consistent with previous findings in the literature (Campbell and Dietrich (1983), Elul et al. (2010), Demyanyk and Van Hemert (2011)). Columns (4)-(6) compare the same characteristics between strategic and non-strategic defaulters. We find that strategic defaulters have, on average, higher initial credit scores and total income, and lower CLTVs. These results suggest that customers who default strategically are significantly less financially constrained, consistent with the insights of Guiso et al. (2013) and Gerardi et al. (2017).

We proceed to examine the distribution of these characteristics more formally in a regression setting. In the next tables, we report results from linear probability models, which allow us to control for fixed effects at the zip code level. Probit estimates that are typically stronger are available in the appendix. In each table, we report results for two models; in our

first specification, labeled "Defaulter", the dependent variable takes the value 1 for delinquencies and 0 otherwise. The second specification ("Str.Defaulter") examines defaulted customers, where the dependent variable takes the value 1 for strategic defaults and 0 for non-strategic defaults.

Thus, in our strategic default specification we compare strategic to non-strategic defaults, given the event of a delinquency. We focus on the conditional, rather than the unconditional, probability of strategic default, for three reasons. First, the default and non-default states are easily observable, while the strategic and non-strategic default states are not, therefore, we focus on the characteristics that distinguish between the two types of defaulters, rather than comparing strategic defaulters to the entire sample or non-defaulters. Second, from a policy making and enforcement point of view, the separation of strategic and non-strategic defaulters is more informative, since it can be used as basis for targeted audits and policy interventions. Finally, this setting allows us to use in the second specification current variables at the time of default, (current CLTV, loan amount), which are not defined in the absence of a delinquency.

Table III presents for the propensity to default (Columns (1)-(2)) and default strategically (Columns (3)-(4)), controlling for multiple loan and borrower characteristics. Borrowers with lower income, lower credit score, and higher CLTV are more likely to default, consistent with the findings of prior literature. A one standard deviation increase in CLTV increases the likelihood of default by 10-12%, and a one standard deviation increase in borrowers' income decreases the likelihood of default by 6-6.8%.[15]

However, the signs of these coefficients reverse, when strategic default is the dependent variable. More specifically, given the event of a delinquency a higher credit score, higher reported income and lower CLTV significantly increase the probability of strategic default. A one standard deviation increase in homeowners' credit score and income increase the likelihood that a customer will default strategically by 7.7-8.1%. All this findings are consistent

[15] Using probit regressions we find that these estimates become economically larger (see Appendix Tables).

with higher relative ability to pay mortgage obligations for strategic defaulters, compared to defaulters that do not exhibit strategic behavior.

Additionally, the level of interest rate and maturity appear to be positively related to default, although they do not significantly affect the incidence of strategic default. The positive relationship between interest rates and delinquencies is consistent with the existence of hidden information problems (Karlan and Zinman (2009)). Finally, the existence of a cosigner or a guarantor reduces the probability of strategic default; adding a co-signer decreases the likelihood of strategic default by 5%. This finding is consistent with the idea that strategic decisions require coordination, which is harder when multiple parties are involved.

In Table IV we examine groups of interest, while keeping the controls for borrower and loan characteristics used previously. College graduates are less likely to default on their mortgage, indicating these borrowers weathered the crisis more successfully. Higher education per se seems not to be significantly related to strategic behavior, but we revisit the role of educational and occupational specialization in section IV.B3.

Borrowers employed in the private sector exhibit higher propensity to default compared to public employees, consistent with the existence of a public sector wage premium and its slow adjustment during the crisis (Christopoulou and Monastiriotis (2015)). Within the private sector, we find that self-employed professionals are not just more likely to default, but also more prone to exhibit strategic behavior, a result that we relate to tax evasion and preceding moral hazard behavior in section IV.B1. Pensioners, on the other hand, are less likely to default strategically; in general, we find that that older borrower are less prone to strategic behavior, which differs from the insights of Guiso et al. (2013). We attribute this discrepancy, at least partially, to cultural differences. In Greece, of high levels of homeownership, the norm is for people to hold on their homes and pass them to their descendants, in contrast to the United States, where home equity is often treated as a vehicle of "precautionary" savings (Poterba et al. (2011)).

Finally, we examine the effect of marital status variables. Single borrowers are less likely to default, while parenthood increases the probability of a delinquency. However, both variables do not seem to be associated signficantly to strategic default, consistent with the findings of Guiso et al. (2013). One of the most striking results relates to single parent families; single-parents exhibit very high probability of defaulting, consistent with limited resources that the lack of a spouse may entail, but also exhibit one of the lowest levels of strategic default in our sample (21.3%). Therefore, single-parent families even though default more frequently, in the vast majority of cases, their failure to meet their mortgage payments is non-strategic.

## B. Determinants of Strategic Default

### B1. Tax Evasion and Strategic Default

A very interesting and robust result from our previous analysis is that self-employed professionals not only are more likely to default, but they are also more likely to default strategically. The higher default rate among self-employed individuals is not surprising considering the pro-cyclicality of their income relative to wage workers or pensioners. The large difference in the propensity to default strategically, however, is surprising and prompts the question we address in this section.

We investigate whether the higher propensity to default strategically is related to another prominent characteristic of self-employment; tax evasion. Strategic default behavior and income tax evasion are both symptoms of moral hazard. Therefore, we examine whether individuals who evade taxes are also more likely to exhibit strategic behavior.

There is strong evidence in the literature that self-employment status highly correlates with tax evasion, mainly due to the lack of third-party reporting to enforce tax compliance (Kleven et al. (2016)). Kleven et al. (2011) show that income underreporting in Denmark is concentrated among taxpayers that self-report their income. Artavanis et al. (2016) find that self-employed professionals in Greece hide almost half of their income from tax authorities and identify medicine, law, engineering, and finance as the top-evading industries.

Individuals who tax evade choose to hide their income and assets, and, therefore, assessing their "ability to pay" using observable information from financial datasets is particularly challenging. This can explain why, even in settings where informality is low, a large number of borrowers continue to serve their mortgages despite the absence of formal liquidity (Gerardi et al. (2017). In contrast, our criterion is not subject to this limitation, as it is based solely on the observed behavior of the borrowers.

In Table V we model the strategic default behavior of self-employed professionals in greater detail. In the first two specifications, the coefficient of self-employment status is positive and highly significant; self-employed individuals are approximately 6-7% more likely to default strategically. In the third specification, we match mortgagors who are self-employed (treated) with wage workers (control) based on their exact job description, as well as on their credit score and CLTV.[16] The coefficient of self-employment remains positive and highly significant.

So far we have established that self-employed professionals, who according to the literature are more prone to evasion, exhibit higher propensity to default strategically. However, in order to link the two types of moral hazard, we need a measure of tax evasion. We follow the intuition of Artavanis et al. (2016), who estimate tax evasion multipliers from credit capacity extended to borrowers by commercial banks, which are shown to take into account unreported income while making credit decisions. Their methodology estimates tax evaded income by comparing credit extended to self-employed and wage workers, who are assumed to report their true income, while controlling for a host of customer and loan characteristics. The results come in the form of multipliers that map reported to true income, according to the bank's model, which justifies the level of the provided credit.

For this method, we ideally want to focus on the marginal borrower; the one that exhausts her credit capacity. Because we do not have information on whether the mortgage provided is close to the borrower credit capacity, we only keep mortgages with CLTV over 50%;

[16]This test requires the existence of both wage workers and self-employed within the job description level, which reduces our sample by two thirds; for example, in the law industry, we keep lawyers, but exclude judges, as the latter group consists exclusively of wage workers.

this way we focus on mortgagors that borrow substantially towards the purchase of their primary home. This control does not alleviate concerns that our borrower might chose a property below her full credit capacity. However, buying a house in Greece is usually a lifetime decision, in contrast to other markets where the existence of entry houses and frequent flipping of properties is the norm. Therefore, the assumption that Greek mortgagors attempt to buy the "best house" they can afford in the long-run, and consequently exhaust their credit capacity, might not be absolutely accurate, but it is not unreasonable.

We use two models to estimate indicators of evading activity. Our first measure is based on estimates of the sensitivity of reported income to credit capacity for all self-employed professionals, controlling for customer and loan characteristics (Eq. (1)). Then, we calculate indicator of evading activity $\kappa_i$, as the ratio of the credit capacity the bank offers to the customer over the predicted credit capacity by customer and mortgage characteristics from equation (1).

$$\mathrm{Cc}_i = \alpha_i + \beta_1 \cdot \mathrm{Y}_i^R + \beta_2 \cdot \mathbb{X}_i + \beta_3 \cdot \mathbb{Y}_i + \varepsilon_i \tag{1}$$

$$\kappa_i = \frac{Cc_i}{\widehat{Cc_i}} \tag{2}$$

where i denotes the borrower, $Cc$ the credit capacity extended by the bank, $Y^R$ the reported income, $\mathbb{X}$ is a vector of customer characteristics (credit score, job description) and $\mathbb{Y}$ a vector of the mortgage characteristics (CLTV, loan amount, interest rate, maturity).

In our second specification, we replicate the methodology of Artavanis et al. (2016), at a very detailed job description level. As in Pissarides and Weber (1989), we also assume that wage workers do not (or cannot) evade taxes. Next, we estimate the sensitivity of credit capacity to true income for wage workers ($\beta_1$) and the sensitivity of credit capacity to reported income for self-employed professionals within a detailed job specification level ($\beta_{2j}$). Finally, we estimate the tax evasion multiplier as the ration of the job category sensitivity

over the wage worker sensitivity of credit capacity to (true) income (4).

$$\text{Cc}_{ij} = \alpha_j + \beta_1 Y_i^T \cdot \mathbb{I}_{ww_i} + \beta_{2j} Y_i^R \cdot \mathbb{I}_{se_{ij}} + \gamma_1 \cdot \mathbb{X}_i + \gamma_3 \cdot \mathbb{Y}_i + \varepsilon_{ij} \tag{3}$$

$$\lambda_j = \frac{\beta_{2j}}{\beta_1} \tag{4}$$

The interpretation of the two tax evasion indicators is different. In the first specification, coefficient $\kappa$ captures the sensitivity of credit capacity to reported income at the individual level with respect to all other self-employed professionals only. In the second specification, our model incorporates the assumption that wage workers do not evade, and uses this group as a reference point. Then, tax evasion multipliers ($\lambda$) for self-employed are estimated at the job description level relative to the reference group.

In Table VI, we use the indicators of evading activity ($\kappa$, $\lambda$) as independent variables in our usual regression setting. Column 1 shows that self-employed professionals that receive a higher level of credit than their piers, after controlling for reported income and other observable characteristics are more likely to default strategically. In Column 2, the tax evasion multiplier ($\lambda$) is also significantly and positively related to the propensity of exhibiting strategic default behavior. The second specification allows for an intuitive way to quantify the effect; An additional 9,000 euros in evaded income (i.e., one standard deviation of evaded income among all self-employed individuals), the probability to default strategically increases by 3.7%. Collectively, our results suggest that not only individuals that have engaged in moral hazard behavior in the past—tax evasion— are more likely to exhibit similar behavior in the future—strategic default, but also that the intensity of the past moral hazard behavior matters.

### B2. Liquidity Preference and Strategic Default

The literature points to two factors that motivate strategic default behavior; the existence of negative equity, and the preference for (precautionary) liquidity. The *negative equity*

*hypothesis* suggests that borrowers become delinquent despite their ability because the cost of the mortgage is greater than the market value of the house (Bajari et al. (2008)). The *liquidity preference hypothesis* attributes strategic default to the willingness of debtors to maintain a certain level of liquidity (Cohen-Cole and Morse (2010)). It is important to note that these two channels are not mutually exclusive, as they can affect borrower behavior simultaneously. For instance, negative equity and liquidity shocks play an important role for mortgage default, which is also the context of double-trigger models (Vandell (1995), Elul et al. (2010)).

A common misconception is that negative equity is a necessary condition for strategic default. However, this is true only for a specific class of debt obligations; secured loans that are contracted in non-recourse states. In recourse states —which are the norm outside the United States— the borrower remains responsible for the residual debt. Therefore, the option to walk away from an "underwater" loan does not reduce the size of the debt obligation. Furthermore, for unsecured loans the concept of equity cannot be defined, due to the lack of collateral, however strategic behavior also occurs in these case (see Gross and Souleles (2002), Yannelis (2016)).

The liquidity preference hypothesis is more widely applicable, as it can motivate strategic default behavior in the presence of recourse and the absence of collateral. Unfortunately, in contrast to negative equity that can be estimated relatively accurately, testing the individuals' preference for liquidity requires knowledge of both current and desired (optimal) levels of liquidity, both of which are difficult to assess. Despite these challenges, the liquidity preference channel can provide an explanation for strategic behavior, even when mortgages are not underwater, as in Mayer et al. (2014), where a loan modification plan increased delinquency rates even for positive equity mortgages.

Our setting offers a unique opportunity to examine the liquidity channel in a class of loans, for which, typically, the negative equity hypothesis is dominant. Testing this hypothesis is possible because the implementation of the foreclosure moratorium has two important implications. First, the inability to foreclose the collateral transforms previously secured

loans to de facto unsecured. Thus, the negative equity condition becomes less binding, even in a recourse state like Greece. Second, given that banks cannot foreclose primary residences, defaulters do not have to acquire alternative housing services and realize the entirety of the foregone debt payment as a positive liquidity shock. In short, the moratorium mutes the effect of negative equity to a certain degree, while it underpins the importance of the liquidity channel.

To support the view that the negative equity channel becomes less important post-moratorium, we first show that defaults (strategic or not) occur in our sample for both positive and negative equity mortgages. The vast majority of mortgages in our sample has CLTV significantly less than one at the time of the moratorium implementation (Fig. 4a), and more than 50% remains with positive equity at the end of our sample period, after the collapse of the real-estate market and the peak in defaults (Fig. 4b). Focusing on delinquencies, over 83% of total defaults (Fig.4c) and 80% of strategic defaults (Fig.4d) refer to positive equity mortgages at the time of default.

In order to examine the effect of the liquidity channel on strategic default behavior, we look into borrowers who experienced different cash flow shocks during the crisis. We hypothesize individuals, who realized significant adverse liquidity shocks will also exhibit a strong preference for liquidity to restore their prior state. There are important challenges in identifying such liquidity shocks, especially due to the difficulty to obtain reliable income information when tax evasion and income underreporting are pervasive (see Artavanis et al. (2016)).

To address these identification challenges, we focus our analysis only on pensioners; pensions in Greece are typically third-party reported by the state, which mitigates concerns for underreporting (Kleven et al. (2011)). Furthermore, pension reductions, due to austerity measures, were not implemented uniformly, as the government attempted to protect lower income pensioners. According to Tinios (2016), there were 13 distinct pension cuts between 2010 and 2013, resulting to realized pension reductions in excess of 30% for high income

pensioners, while low pensions were hardly affected or even received small increases in some cases.

In Table VII we examine the propensity to default (column 1) and default strategically for pensioners of different income quartiles (columns 2-4). The effect of income on probability of default is monotonic—higher income pensioners are less likely to become delinquent on their mortgage obligations (see column 1). Turning to strategic default, we find that high income pensioners, who experienced the largest pension cuts, exhibit significantly higher propensity to default deliberately (column 2). High income pensioners, who suffered the biggest pension cuts, are on average, 13-14% more likely to default strategically than other groups of pensioners. On the other hand, negative equity does not affect the likelihood of strategic default in this setting (columns 3 & 4). Taken together, our findings suggest that experiencing an adverse liquidity shock significantly increases the probability of exhibiting strategic behavior, as borrowers attempt to offset these shocks by defaulting on their mortgage payments.

### B3. The Role of Financial and Legal Literacy

This section examines the industry distribution of strategic default to assess whether employment specialization has explanatory power towards the incidence of strategic behavior. Figure 4 presents default and strategic default rates, and the strategic default ratio, defined as the number of strategic defaulters over defaulters, for professionals in ten broad industries. We find the economic crisis had a large impact on farmers and blue collar workers, as around 60% of borrowers in these groups have become delinquent. In contrast, professionals in industries such as law, finance, and medicine have weathered the crisis more successfully as shown by their significantly lower default rates.

The strategic default rate appears to have little variation across industries, ranging from 15% to 20% for all groups, with exception of military. In contrast, the strategic default ratio—the concentration of strategic defaulters among defaulters— differs significantly among professional groups. A distinct pattern of Figure 4 is that industries with higher

default rates have lower concentrations of strategic defaulters.[17] This finding suggests that delinquencies in professional groups that have weathered the crisis more successfully have considerably higher concentrations of strategic defaulters.

Military and security personnel exhibit the lowest strategic default rate (8%) and strategic default ratio (19%). We attribute this finding to distinct moral attributes of this group, related to an increased sense of duty or enahnced self-perceived social stigma that prevents these professionals from engaging in moral hazard. This explanation is used by Akerlof and Kranton (2005) to explain differences in pay-schedules between military and civilian organizations.

Next, we focus on high-profile professions that typically require higher education. The previous results indicate that borrowers with a college degree are less likely to default, but educational status does not appear to significantly affect the decision to default strategically (see Table IV). Focusing on these professions, in Figure 4, we observe a clear dichotomy; educators, doctors and other scientists exhibit relative low strategic default ratios, close to the sample average. In contrast, the highest strategic default ratios appear for professionals in the industries of law (47.5%) and finance (41%); notably, these groups have relatively low overall default rates (15.5% and 8%).

We examine these patterns in a multivariate setting in order to control for personal and mortgage loan characteristics. The results are reported in Table VIII. Consistent with the findings in Figure 4, blue collar workers and farmers are significantly more likely to default. On the other hand, professionals in high-profile industries such as medicine, law, finance, science, and education are considerably less likely to default. Military personnel remains an outlier with significantly negative coefficients for the propensity both to default and strategically default.

The stark contrast in probability of default and strategic default among high-profile professions is also evident in Table VIII; doctors, educators, and other scientists are not (statistically) more likely to default strategically (column 2). On the other hand, profes-

[17] The correlation between default rates and the strategic default ratios is -0.37.

sionals in law and finance are approximately 3.8-4.9% more likely to default strategically, indicating that defaults in these industries are far more probable to be strategic. These findings suggest that borrowers who understand the legal and financial ramifications of the foreclosure moratorium are more likely to act strategically by foregoing mortgage payments without declaring personal bankruptcy. These results are are in line with the findings of Amromin et al. (2011), who show that more financially sophisticated households tend to hold complex mortgage products, in order to increase the option value of strategic default.

In Table X we focus on individuals working in law and finance and examine the propensity to default strategically for positive and negative equity mortgages, separately. Interestingly, while the concentration of strategic defaulters in delinquencies of the law industry is similar for the two subsamples, the sensitivity of the response of professionals in finance is higher, if they have negative equity on their house. This result suggests that the two groups not only understand the institutional setting around the moratorium and personal bankruptcy laws, but they also base their actions on different types of information. Law professionals focus on the legal informational content of the moratorium, which protects delinquent borrowers regardless of the equity sign of the mortgage. In contrast, for mortgagors in the finance sector the existence of negative equity is an important factor in their decision to default strategically.

## V. Conclusion

Our study shows that the introduction of an almost universal foreclosure moratorium on primary residences had a significant impact on strategic default and the deterioration of the financial state of the Greek banking system. We conservatively estimate that 28% of defaults in our sample are strategic that corresponds to over 5 billion euros in non-performing loans. Through several bank recapitalizations, the Greek government financed a large part of the cost of moral hazard, redistributing wealth from shareholders and taxpayers toward wealthier and more financially sophisticated homeowners.

Due to its unconditional nature, the foreclosure moratorium fostered strategic behavior. Additionally, the foreclosure moratorium was costly and deprived funds from other targeted provisions that could provide relief to truly over-indebted households.

Moving forward, Greek banks attempt to return to the recovery path by resolving their non-performing loans. A significant portion of delinquent borrowers are strategic, which complicates the sale of these "toxic" assets. The results in this paper support the hypothesis that the foreclosure moratorium is responsible for a large number of strategic delinquencies. Therefore, the lift of the moratorium and the implementation of stricter eligibility criteria for renegotiation will considerably reduce the incidence of strategic defaults, thus increasing the value of these assets.

# References


Akerlof, George A, 1970, The market for" lemons": Quality uncertainty and the market mechanism, *The Quarterly Journal of Economics* 84, 488–500.

Akerlof, George A, and Rachel E Kranton, 2005, Identity and the economics of organizations, *The Journal of Economic Perspectives* 19, 9–32.

Alston, Lee J, 1984, Farm foreclosure moratorium legislation: A lesson from the past, *The American Economic Review* 74, 445–457.

Amromin, Gene, Jennifer Huang, Clemens Sialm, and Edward Zhong, 2011, Complex mortgages, Technical report, National Bureau of Economic Research.

Artavanis, Nikolaos, Adair Morse, and Margarita Tsoutsoura, 2016, Measuring income tax evasion using bank credit: Evidence from greece, *The Quarterly Journal of Economics* 739–798.

Bajari, Patrick, Chenghuan Sean Chu, and Minjung Park, 2008, An empirical model of subprime mortgage default from 2000 to 2007, Technical report, National Bureau of Economic Research.

Bhutta, Neil, Jane Dokko, and Hui Shan, 2017, Consumer ruthlessness and mortgage default during the 2007 to 2009 housing bust, *The Journal of Finance* 72, 2433–2466.

Bolton, Patrick, and Howard Rosenthal, 2002, Political intervention in debt contracts, *Journal of Political Economy* 110, 1103–1134.

Campbell, Tim S, and J Kimball Dietrich, 1983, The determinants of default on insured conventional residential mortgage loans, *The Journal of Finance* 38, 1569–1581.

Christopoulou, Rebekka, and Vassilis Monastiriotis, 2015, Public-private wage duality during the greek crisis, *Oxford Economic Papers* 68, 174–196.

Cohen-Cole, Ethan, and Jonathan Morse, 2010, Your house or your credit card, which would you choose? personal delinquency tradeoffs and precautionary liquidity motives .

Demyanyk, Yuliya, and Otto Van Hemert, 2011, Understanding the subprime mortgage crisis, *Review of financial Studies* 24, 1848–1880.

Dendramis, Yiannis, Elias Tzavalis, and Georgios Adraktas, 2017, Credit risk modelling under recessionary and financially distressed conditions, *Journal of Banking & Finance* .

Elul, Ronel, Nicholas S Souleles, Souphala Chomsisengphet, Dennis Glennon, and Robert Hunt, 2010, What" triggers" mortgage default?, *The American Economic Review* 100, 490–494.

European Comission, Justice, 2014, Report on "european judicial systems – edition 2014 (2012 data): Efficiency and quality of justice", Technical report.

Foote, Christopher L, Kristopher Gerardi, and Paul S Willen, 2008, Negative equity and foreclosure: Theory and evidence, *Journal of Urban Economics* 64, 234–245.

Frame, W Scott, 2010, Estimating the effect of mortgage foreclosures on nearby property values: A critical review of the literature, *Economic Review-Federal Reserve Bank of Atlanta* 95, II.

Gerardi, Kristopher, Kyle F. Herkenhoff, Lee E. Ohanian, and Paul S. Willen, 2017, Can't pay or won't pay? unemployment, negative equity, and strategic default, *The Review of Financial Studies* forthcoming, hhx115.

Ghent, Andra C, and Marianna Kudlyak, 2011, Recourse and residential mortgage default: evidence from us states, *Review of Financial Studies* hhr055.

Giroud, Xavier, Holger M Mueller, Alex Stomper, and Arne Westerkamp, 2012, Snow and leverage, *Review of Financial Studies* 25, 680–710.

Goodstein, Ryan, Paul Hanouna, Carlos D Ramirez, and Christof W Stahel, 2017, Contagion effects in strategic mortgage defaults, *Journal of Financial Intermediation* 30, 50–60.

Gross, David B, and Nicholas S Souleles, 2002, An empirical analysis of personal bankruptcy and delinquency, *Review of financial studies* 15, 319–347.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales, 2013, The determinants of attitudes toward strategic default on mortgages, *The Journal of Finance* 68, 1473–1515.

Haliassos, Michael, Gikas Hardouvelis, Margarita Tsoutsoura, and Dimitri Vayanos, 2016, Financial developement and the credit cycle in greece .

Hurst, Erik, Geng Li, and Benjamin Pugsley, 2014, Are household surveys like tax forms? evidence from income underreporting of the self-employed, *Review of economics and statistics* 96, 19–33.

Karlan, Dean, and Jonathan Zinman, 2009, Observing unobservables: Identifying information asymmetries with a consumer credit field experiment, *Econometrica* 77, 1993–2008.

Kleven, Henrik Jacobsen, Martin B Knudsen, Claus Thustrup Kreiner, Søren Pedersen, and Emmanuel Saez, 2011, Unwilling or unable to cheat? evidence from a tax audit experiment in denmark, *Econometrica* 79, 651–692.

Kleven, Henrik Jacobsen, Claus Thustrup Kreiner, and Emmanuel Saez, 2016, Why can modern governments tax so much? an agency model of firms as fiscal intermediaries, *Economica* 83, 219–246.

Mayer, Christopher, Edward Morrison, Tomasz Piskorski, and Arpit Gupta, 2014, Mortgage modification and strategic behavior: evidence from a legal settlement with countrywide, *The American Economic Review* 104, 2830–2857.

Mian, Atif, and Amir Sufi, 2009, The consequences of mortgage credit expansion: Evidence from the us mortgage default crisis, *The Quarterly Journal of Economics* 124, 1449–1496.

Mian, Atif, and Amir Sufi, 2014, What explains the 2007–2009 drop in employment?, *Econometrica* 82, 2197–2223.

Morse, Adair, and Margarita Tsoutsoura, 2013, Life without foreclosures, *Working paper* .

Paulus, Christoph G, Stathis Potamitis, Alexandros Rokas, and Ignacio Tirado, 2015, Insolvency law as a main pillar of market economy—a critical assessment of the greek insolvency law, *International Insolvency Review* 24, 1–27.

Pence, Karen M, 2006, Foreclosing on opportunity: State laws and mortgage credit, *Review of Economics and Statistics* 88, 177–182.

Pissarides, Christopher A, and Guglielmo Weber, 1989, An expenditure-based estimate of Britain's black economy, *Journal of Public Economics* 39, 17–32.

Poterba, James, Steven Venti, and David Wise, 2011, The composition and drawdown of wealth in retirement, *Journal of Economic Perspectives* 25, 95–118.

Stiglitz, Joseph E, and Andrew Weiss, 1981, Credit rationing in markets with imperfect information, *The American Economic Review* 71, 393–410.

Tinios, Platon, 2016, Towards a new social contract: Greek pensions halfway through adjustment .

Vallender, H., H. Allemand, S. Baister, P. Kuglarz, H. Mathijsen, B. O'Neill, E. Collins, and S. Potamitis, 2013, A minimum standard for debt discharge in europe?, *Insolvency Intelligence* 26, 97–104.

Vandell, Kerry D, 1995, How ruthless is mortgage default? a review and synthesis of the evidence, *Journal of Housing Research* 6, 245.

Yannelis, Constantine, 2016, Strategic default on student loans, *Working paper* .

# Figures

**Figure 1: Identification of Strategic Default.**

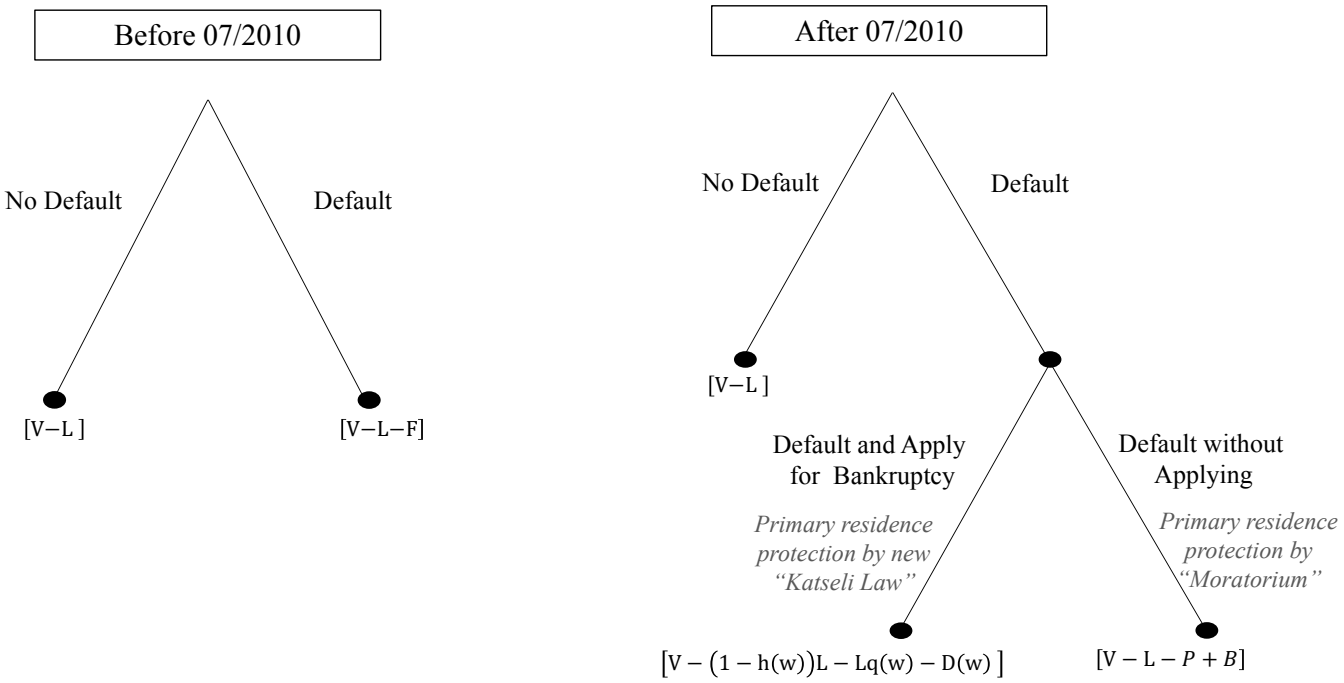


**Figure 2:** The histogram presents the distribution of objective values for the full sample of primary residence mortgages, excluding loans guaranteed by the state and loans with subsidized interest rates. A primary residence is protected from foreclosure if the objective value of the collateral is is below €300,000 (vertical line). The threshold for primary residencies that are protected increases to €350,000 if the borrower is married, and increases by €50,000 more for each child in the household.

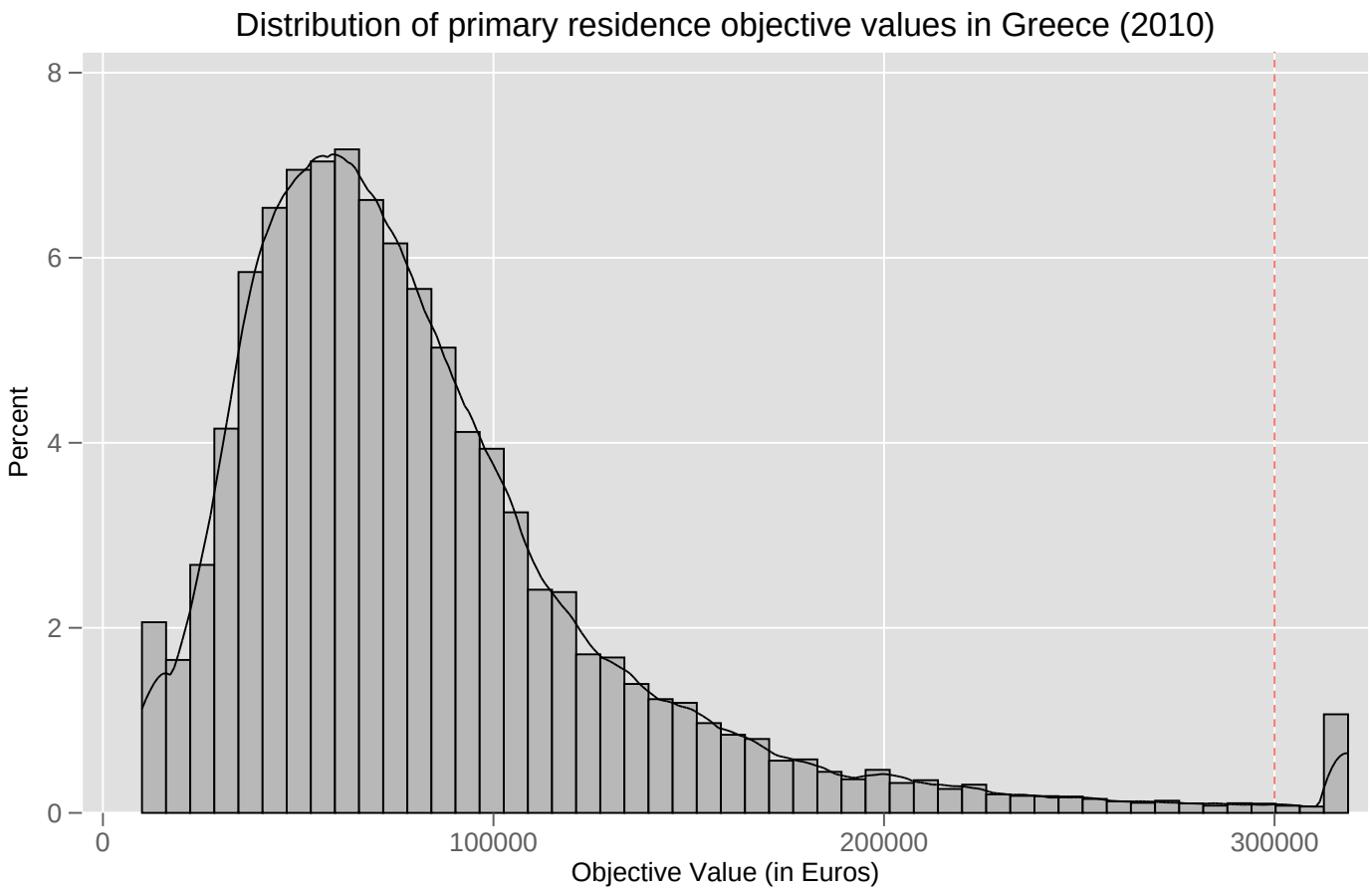


**Figure 3:** The graph presents cumulative default rates on a monthly frequency for the entire sample of primary residence (straight line) and secondary residence (dashed line) mortgages. The sample includes mortgages contracted after January of 2007. Mortgages guaranteed by the state and with subsidized interest rates are excluded. The dash-dot line depicts the difference in default rates between primary and secondary residence. Delinquency is defined as the delay of payment for an amount equal to 6 monthly payments (t+6 rule). The horizontal line depicts the implementation time of regulation N.3869/2010 and N.3858/2010.

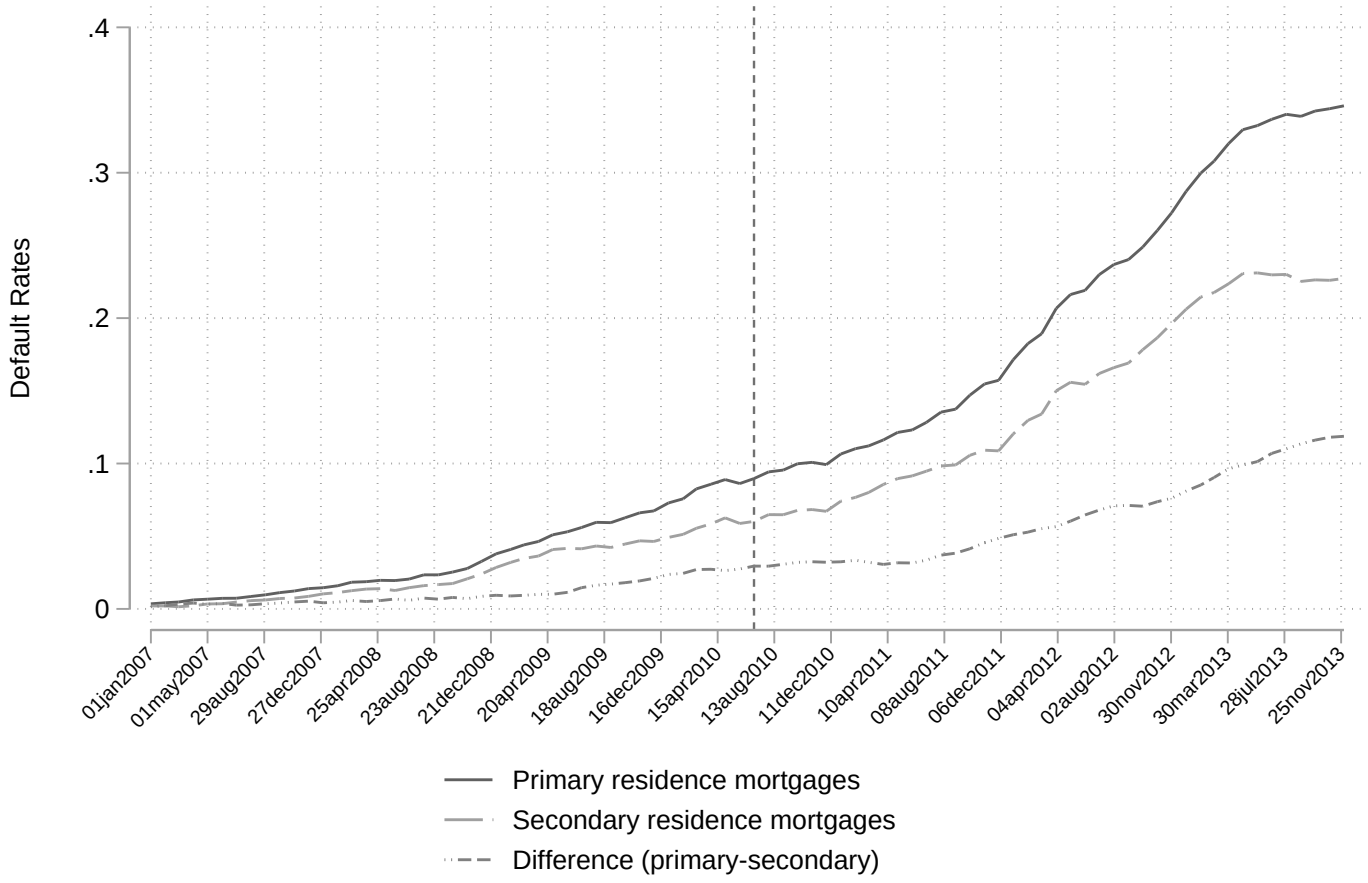


**Figure 4:** The graph presents strategic default ratios, defined as the ratio of strategic defaulters over non-strategic defaulters, and overall default rates, across industries. Defaults and strategic defaults are as of December 2013. The horizontal line represents the sample average rate of strategic defaults (29%).

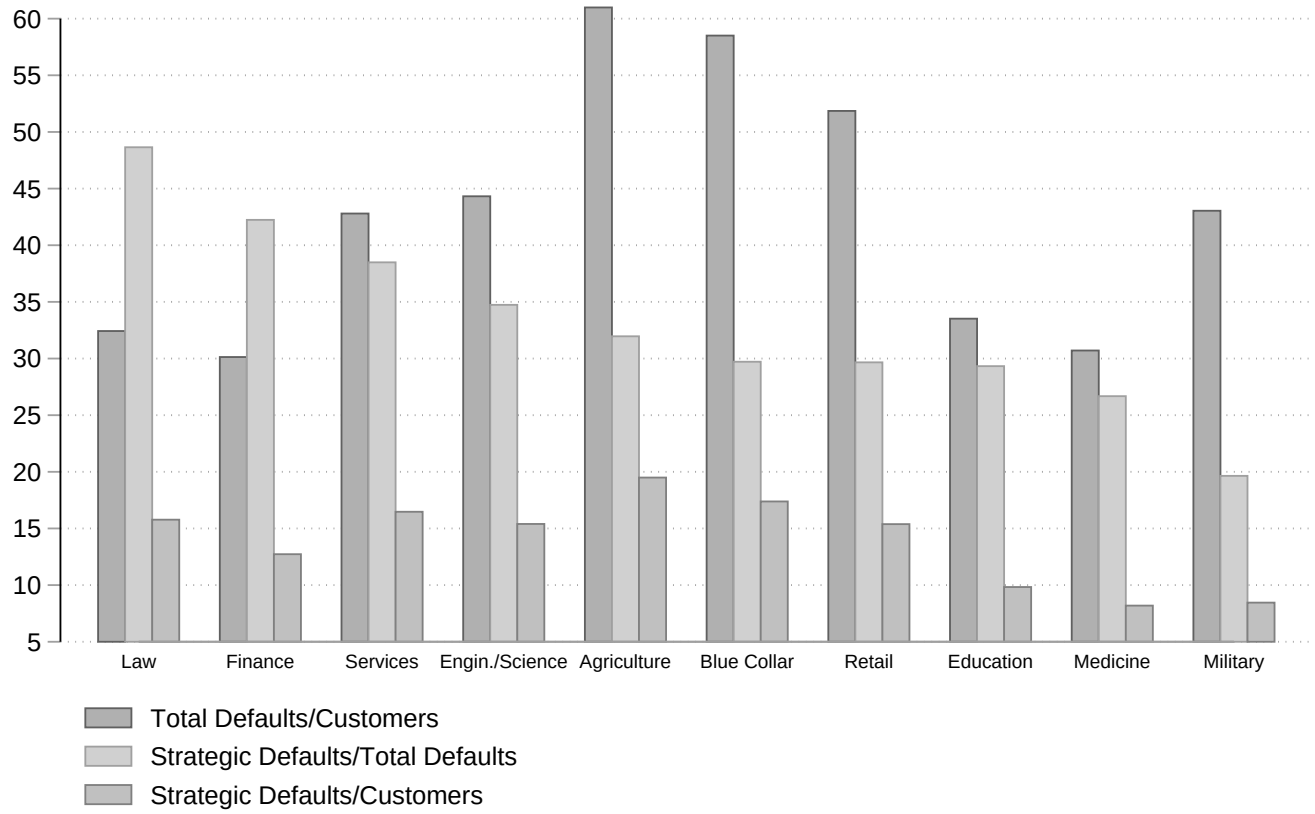
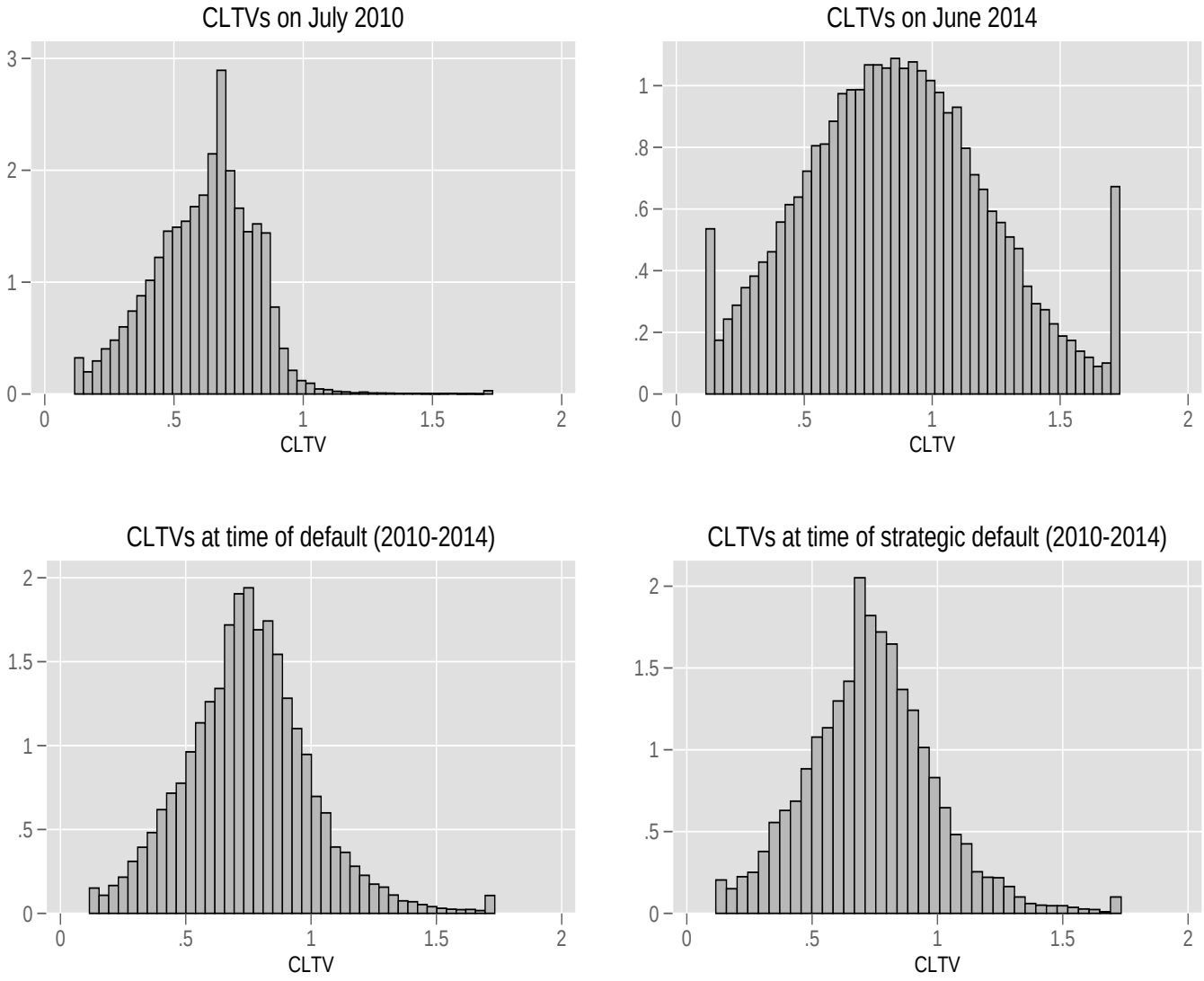


**Figure 5:** The histograms present the distribution of current LTV values of primary residence mortgages in three different time periods. The first plot (a-top left) shows the distribution of CLTVs on July 2010, which is the date of the implementation of the foreclosure moratorium and the introduction of the new personal bankruptcy regulation (Katseli Law). The plot on top right (b) shows the distribution of CLTVs of individuals at the time they default during the period July 2010 until June 2014. The third plot (c-bottom left) shows the distribution of CLTVs at the end of our sample period—June 2014. The fourth plot (d-bottom right) shows



# Tables

**Table I: Summary Statistics of Mortgages on Primary Residences**
The table presents summary statistics of primary residential mortgages from 2007 until 2013. We use mortgage, dwelling, and customer characteristics from mortgage applications and performance information at the date of the foreclosure moratorium regulation (July 2010).

| | N | Mean | sd | p10 | p50 | p90 |
|---|---|---|---|---|---|---|
| **Loan Characteristics** | | | | | | |
| Loan Amount (K) | 57854 | 103.33 | 73.14 | 33.60 | 87.00 | 198.90 |
| Monthly Installment | 57854 | 518.95 | 362.80 | 153.55 | 449.86 | 964.07 |
| Interest Rate | 57854 | 4.08 | 1.09 | 2.62 | 4.07 | 5.42 |
| Maturity (years) | 51279 | 24.52 | 9.27 | 12.00 | 25.00 | 40.00 |
| Num. people involved | 51279 | 1.85 | 0.71 | 1.00 | 2.00 | 3.00 |
| CLTV | 50530 | 0.62 | 0.20 | 0.35 | 0.64 | 0.85 |
| **Dwelling Characteristics** | | | | | | |
| Commercial Value | 55915 | 158.26 | 99.88 | 65.01 | 136.42 | 273.00 |
| Objective Value | 41708 | 78.90 | 49.78 | 30.41 | 67.50 | 141.18 |
| **Customer Characteristics** | | | | | | |
| Credit Score | 51326 | 651.74 | 99.99 | 552.00 | 648.00 | 753.00 |
| Reported Income | 52346 | 14.54 | 13.70 | 0.00 | 12.23 | 30.00 |
| Total Income | 52833 | 31.13 | 21.04 | 12.16 | 25.72 | 55.23 |
| College Education | 45850 | 0.29 | 0.45 | 0.00 | 0.00 | 1.00 |
| Age | 50850 | 51.09 | 11.85 | 36.00 | 50.00 | 68.00 |
| **Default Statistics** | | | | | | |
| Defaulter | 57854 | 0.42 | 0.49 | 0.00 | 0.00 | 1.00 |
| Str. Defaulter | 57854 | 0.12 | 0.32 | 0.00 | 0.00 | 1.00 |

**Table II: Univariate differences**

This table presents average mortgage and customer characteristics for delinquent (column 1) and non-delinquent borrowers (column 2). We define a customer as *defaulter* if he has been delinquent for at least six months, and *non-defaulter* otherwise. We define as *strategic defaulter* a customer that defaults before December of 2013 and does not apply for the debt discharge provision of the "Katseli-Law". We define borrowers who default and apply for debt discharge as *non-strategic defaulters*. The third column shows the univariate difference in average characteristics between defaulting and non-defaulting customers, and the last column shows the difference in the characteristics between strategic and non-strategic defaulters. CLTV is based on July 2010, or at the time of default for defaulters.

| | (1) Non-Defaulters | (2) Defaulters | (1)-(2) | (4) Non-strategic defaulters | (5) Strategic defaulters | (4)-(5) |
|---|---|---|---|---|---|---|
| Loan Amount (K) | 99.61 | 108.55 | -8.94*** | 107.96 | 110.08 | -2.12 |
| Monthly Installment | 524.84 | 510.68 | 14.16*** | 494.70 | 551.63 | -56.93*** |
| Interest Rate | 4.06 | 4.11 | -0.05*** | 4.09 | 4.16 | -0.07*** |
| Maturity (years) | 23.26 | 26.31 | -3.05*** | 26.64 | 25.49 | 1.15*** |
| Num. people involved | 1.86 | 1.84 | 0.02** | 1.84 | 1.82 | 0.02* |
| CLTV (at default) | 0.59 | 0.75 | -0.16*** | 0.76 | 0.74 | 0.02*** |
| Commercial Value | 155.78 | 161.75 | -5.97*** | 158.82 | 169.22 | -10.40*** |
| Objective Value | 80.19 | 77.23 | 2.96*** | 75.95 | 80.75 | -4.80*** |
| Credit Score | 672.84 | 621.90 | 50.94*** | 614.33 | 640.49 | -26.16*** |
| Reported Income | 15.75 | 12.85 | 2.90*** | 12.78 | 13.04 | -0.27 |
| Total Income | 33.19 | 28.28 | 4.91*** | 27.36 | 30.55 | -3.19*** |
| College Education | 0.35 | 0.20 | 0.15*** | 0.19 | 0.22 | -0.03*** |
| Age | 51.11 | 51.06 | 0.05 | 51.28 | 50.53 | 0.75*** |

**Table III: Determinants of defaults and strategic defaults in primary residence mortgages**
This table presents OLS regressions of defaulting customers on borrower and mortgage characteristics. In Columns (1)-(2), the dependent variable is an indicator variable that equals one if the customer defaulted (delinquent for six consecutive months). In Column (3)-(4) the dependent variable is an indicator variable that takes the value of 1 if the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). Regression coefficients are based on standard deviations of the independent variable (standardized). Standard errors are clustered by zip code and are reported below each regression coefficient. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Defaulter** | (3) **Str.Defaulter** | (4) **Str.Defaulter** |
|---|---|---|---|---|
| Credit Score | -0.1955*** | -0.1875*** | 0.0776*** | 0.0809*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Total Income | -0.0670*** | -0.0609*** | 0.0579*** | 0.0728*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CLTV | 0.1199*** | 0.0987*** | -0.0945*** | -0.0940*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Loan Amount (K) | 0.0683*** | 0.0477*** | 0.0185** | 0.0217** |
| | (0.000) | (0.000) | (0.038) | (0.021) |
| Interest Rate | | 0.0168*** | | 0.0152* |
| | | (0.001) | | (0.057) |
| Maturity (years) | | 0.0733*** | | -0.0026 |
| | | (0.000) | | (0.766) |
| Num. people involved | | 0.0094 | | -0.0503*** |
| | | (0.112) | | (0.000) |
| Zip Code FEs | Yes | Yes | Yes | Yes |
| Observations | 44006 | 44006 | 18047 | 18047 |
| Adjusted $R^2$ | 0.099 | 0.103 | 0.039 | 0.041 |

**Table IV: Mortgage and borrower characteristics**

This table presents OLS regressions of defaulting customers on borrower and mortgage characteristics. In Columns (1-2) the dependent variable is an indicator variable that equals one if the customer defaulted (delinquent for six consecutive months). In Column (3-4) the dependent variable is an indicator variable that takes the value of 1 if the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). Regression coefficients are based on standard deviations of the independent variable (standardized). Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Defaulter** | (3) **Str.Defaulter** | (4) **Str.Defaulter** |
|---|---|---|---|---|
| Credit Score | -0.0008*** | -0.0008*** | 0.0003*** | 0.0003*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Total Income | -0.0008*** | -0.0009*** | 0.0017*** | 0.0017*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CLTV | 0.2348*** | 0.2420*** | -0.2099*** | -0.2100*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Loan Amount (K) | 0.0000*** | 0.0000*** | 0.0000 | 0.0000 |
| | (0.000) | (0.000) | (0.161) | (0.168) |
| Interest Rate | 0.0067*** | 0.0069*** | 0.0054 | 0.0056 |
| | (0.006) | (0.005) | (0.134) | (0.122) |
| Maturity (years) | 0.0038*** | 0.0040*** | -0.0004 | -0.0003 |
| | (0.000) | (0.000) | (0.426) | (0.537) |
| Num. people involved | -0.0044 | -0.0058 | -0.0253*** | -0.0279*** |
| | (0.303) | (0.175) | (0.000) | (0.000) |
| College Education | -0.1192*** | -0.1144*** | 0.0155 | 0.0172 |
| | (0.000) | (0.000) | (0.183) | (0.138) |
| Private Sector | 0.0403*** | 0.0427*** | 0.0065 | 0.0069 |
| | (0.000) | (0.000) | (0.500) | (0.470) |
| Self-employed | 0.0579*** | 0.0574*** | 0.0743*** | 0.0737*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Pensioner | -0.0094 | -0.0047 | -0.0657*** | -0.0627*** |
| | (0.247) | (0.568) | (0.000) | (0.000) |
| Single | | -0.0292*** | | -0.0034 |
| | | (0.000) | | (0.742) |
| Parent | | 0.0230*** | | 0.0125 |
| | | (0.000) | | (0.194) |
| Single-Parent | | 0.0748*** | | -0.0897*** |
| | | (0.000) | | (0.000) |
| Zip Code FEs | Yes | Yes | Yes | Yes |
| Observations | 39626 | 39626 | 15917 | 15917 |
| Adjusted $R^2$ | 0.115 | 0.117 | 0.046 | 0.047 |

**Table V: Strategic defaults and ease of tax-evasion**

This table presents coefficients from cross-sectional OLS regressions of strategic defaulters on customers' ability to tax evade. In regressions (1)-(3), the dependent variable is an indicator variable that equals one when the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). Regression (2) includes an indicator variable for all customers that have the same job description (job ID fixed effects). Regression (3) focuses on a sample of self-employed individuals (treated group) matched with wage workers (control group) based on the the same job description and similar credit characteristics. Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Str. Defaulter** | (2) **Str.Defaulter** | (3) **Str.Defaulter** (matched sample) |
|---|---|---|---|
| Self-employed | 0.0707*** | 0.0640*** | 0.0595*** |
| | (0.000) | (0.000) | (0.003) |
| *Controls* | | | |
| Credit Score | 0.0877*** | 0.0957*** | 0.0945*** |
| | (0.000) | (0.000) | (0.000) |
| Total Income | 0.0664*** | 0.0593*** | 0.0808*** |
| | (0.000) | (0.000) | (0.000) |
| CLTV | -0.0946*** | -0.0885*** | -0.0985*** |
| | (0.000) | (0.000) | (0.000) |
| Loan Amount (K) | 0.0125 | 0.0095 | 0.0211 |
| | (0.210) | (0.326) | (0.259) |
| Interest Rate | 0.0168** | 0.0230*** | 0.0304 |
| | (0.048) | (0.008) | (0.110) |
| Maturity (years) | -0.0061 | -0.0030 | -0.0186 |
| | (0.528) | (0.751) | (0.371) |
| Num. people involved | -0.0431*** | -0.0411*** | -0.0467** |
| | (0.000) | (0.000) | (0.017) |
| Zipcode FEs | Yes | Yes | Yes |
| Job FEs | No | Yes | Yes |
| Observations | 16380 | 16240 | 7047 |
| Adjusted $R^2$ | 0.049 | 0.055 | 0.151 |

**Table VI: Strategic defaults and ease of tax-evasion— Multipliers of tax-evasion**
This table presents coefficients from cross-sectional OLS regressions of strategic defaulters on customers' ex ante estimates of tax evasion. The dependent variable in all regressions is an indicator variable that equals one if the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). In regression (1), *tax evasion proxy-*$\kappa$ is an estimate of tax evasion based on the excess credit capacity extended to a self-employed professional relative to a wage-worker with similar personal and loan characteristics. In regression (2), *tax evasion proxy-*$\lambda$ is the ratio of the sensitivity of credit capacity to income for self-employed professionals (who are able to tax evade) divided by the sensitivity of credit capacity to income for wage-workers (that are not able to tax evade). Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1)<br>**Str. Defaulter** | (2)<br>**Str.Defaulter** |
|---|---|---|
| Lambda (predicted) | 0.1211*** | |
| | (0.000) | |
| Lambda (constrained) | | 0.0373** |
| | | (0.047) |
| *Controls* | | |
| Credit Score | 0.1282*** | 0.1284*** |
| | (0.000) | (0.000) |
| Total Income | 0.0944*** | 0.0953*** |
| | (0.000) | (0.000) |
| CLTV | -0.0904*** | -0.0928*** |
| | (0.000) | (0.000) |
| Loan Amount (K) | -0.0811*** | 0.0137 |
| | (0.005) | (0.504) |
| Interest Rate | 0.0124 | 0.0099 |
| | (0.531) | (0.618) |
| Maturity (years) | 0.0226 | -0.0048 |
| | (0.318) | (0.827) |
| Num. people involved | -0.0538*** | -0.0570*** |
| | (0.008) | (0.005) |
| Zipcode FEs | Yes | Yes |
| Observations | 3224 | 3224 |
| Adjusted $R^2$ | 0.083 | 0.079 |

**Table VII: Cash flow shocks and strategic default**

This table presents coefficients from cross-sectional OLS regressions of pensioners. We classify pensioners as high-income, medium-income, and low-income based on the distribution of the personal income in their mortgage applications (low-income group is omitted). The dependent variable in regression (1) is an indicator variable that equals one if the customer defaulted and zero otherwise. In regression (2), the dependent variable is an indicator variable that equals one when the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). *Negative Equity* is an indicator variable that equals one if the CLTV of the customer at the time of default is above one. Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Str.Defaulter** | (3) **Str.Defaulter** | (4) **Str.Defaulter** |
|---|---|---|---|---|
| Pensioner income Q2 | -0.0009 | 0.0118 | -0.0023 | 0.0020 |
| | (0.955) | (0.646) | (0.941) | (0.954) |
| Pensioner income Q3 | -0.0656*** | 0.0531* | 0.0383 | 0.0198 |
| | (0.000) | (0.059) | (0.251) | (0.571) |
| Pensioner income Q4 (high) | -0.0979*** | 0.1219*** | 0.1278*** | 0.1401*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Negative Equity | | | 0.0114 | 0.0090 |
| | | | (0.671) | (0.872) |
| Negative Equity * Pensioner Income Q2 | | | | -0.0123 |
| | | | | (0.777) |
| Negative Equity * Pensioner Income Q3 | | | | 0.0502 |
| | | | | (0.252) |
| Negative Equity * Pensioner Income Q4 | | | | -0.0336 |
| | | | | (0.380) |
| Zip Code FEs | Yes | Yes | Yes | Yes |
| Observations | 5518 | 1906 | 1414 | 1414 |
| Adjusted $R^2$ | 0.089 | 0.022 | 0.012 | 0.013 |

**Table VIII: Strategic Defaults Across Industries**
This table presents coefficients from cross-sectional OLS regressions of customers who default strategically. The dependent variable is an indicator variable that equals one when the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Str.Defaulter** |
|---|---|---|
| Credit Score | -0.1896*** | 0.0842*** |
| | (0.000) | (0.000) |
| Total Income | -0.0486*** | 0.0502*** |
| | (0.000) | (0.000) |
| CLTV | 0.1133*** | -0.0937*** |
| | (0.000) | (0.000) |
| Loan Amount (K) | 0.0692*** | 0.0114 |
| | (0.000) | (0.261) |
| *Occupation Industry* | | |
| Finance | -0.0720*** | 0.0489*** |
| | (0.000) | (0.000) |
| Law | -0.0168*** | 0.0383*** |
| | (0.003) | (0.000) |
| Medicine | -0.0552*** | -0.0118 |
| | (0.000) | (0.221) |
| Engin./Science | -0.0000 | 0.0022 |
| | (0.995) | (0.830) |
| Blue Collar | 0.0392*** | 0.0056 |
| | (0.000) | (0.651) |
| Military | -0.0211*** | -0.0410*** |
| | (0.001) | (0.000) |
| Services | -0.0230*** | 0.0197* |
| | (0.000) | (0.055) |
| Retail | 0.0141 | 0.0059 |
| | (0.116) | (0.694) |
| Agriculture | 0.0174** | -0.0051 |
| | (0.010) | (0.646) |
| Education | -0.0352*** | -0.0166* |
| | (0.000) | (0.090) |
| Zip Code FEs | Yes | Yes |
| Observations | 33020 | 14015 |
| Adjusted $R^2$ | 0.115 | 0.049 |

**Table X: Financial education and strategic default**

This table presents coefficients from cross-sectional OLS regressions of customers who default strategically. The dependent variable is an indicator variable that equals one when the customer is delinquent for six consecutive months and did not apply for debt discharge (defaults strategically). *Finance* indicates individuals working in finance or accounting, and *Law* indicates individuals working in law and other legal services. *Negative Equity* is an indicator variable that takes the value of one if the CLTV of the customer at the time of default is above one. Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1)<br>**Str.Defaulter**<br>(Negative equity) | (2)<br>**Str.Defaulter**<br>(Positive equity) | (3)<br>**Str.Defaulter**<br>(Full sample) |
|---|---|---|---|
| Negative Equity(X)Finance | | | 0.0208** |
| | | | (0.0448) |
| Negative Equity(X)Law | | | 0.0053 |
| | | | (0.1065) |
| Negative Equity | | | 0.0275** |
| | | | (0.0144) |
| Finance | 0.0892*** | 0.0401*** | 0.0429*** |
| | (0.0439) | (0.0248) | (0.0245) |
| Law | 0.0525** | 0.0334*** | 0.0362*** |
| | (0.1137) | (0.0562) | (0.0554) |
| Total Income | 0.0699*** | 0.0512*** | 0.0566*** |
| | (0.0006) | (0.0003) | (0.0002) |
| Loan Amount (K) | -0.0187 | 0.0508*** | 0.0309*** |
| | (0.0000) | (0.0000) | (0.0000) |
| Credit Score | -0.0097 | -0.0075 | -0.0068 |
| | (0.0001) | (0.0001) | (0.0001) |
| Zip Code FEs | Yes | Yes | Yes |
| Observations | 3501 | 11038 | 14539 |
| Adjusted $R^2$ | 0.031 | 0.037 | 0.040 |

# Appendix

**Definition** Let $V$ be the commercial value of the dwelling, $L$ the outstanding value of the loan, and $F$ the foreclosure costs.

In a recourse state, the borrower remains responsible for the residual amount, in the case of delinquency if the mortgage is negative equity ($V - L < 0$). Before the implementation of the law, the possible outcomes and their respective payoffs are as follows (see Figure 1.a):

$$\textit{No Default}\text{: } V - L \qquad \textit{Default}\text{: } V - L - F$$

**Proposition V.1** *Before the implementation of the law, inability to pay and negative equity are necessary conditions for default.*

**Proof** For a borrower with ability to pay, the payoff of non-default is always greater than the payoff of defaulting, in the presence of positive foreclosure and/or credit costs.

$$V - L > V - L - F \Rightarrow F > 0 \tag{5}$$

For a borrower with inability to pay, if the mortgage is positive equity, the optimal strategy is to sell the dwelling, repay the loan and realize the difference, because of (5). If the mortgage is negative equity and the borrower exhibits inability to pay, neither the financial state of the mortgagor nor the value of the dwelling can secure the repayment of the loan (default). ∎

The implementation of the law has two important implications for our setting; (i) it prevents foreclosures, thus foreclosure costs ($F$) are not realized, and (ii) it provides two options for default, "Default and Apply" and "Default and Not Apply" for bankruptcy (see Figure 1.b).

**Definition** Let $w \in [0, +\infty)$ be the borrower's ability to pay.

**Definition** Let $Lq(w)$ and $D(w)$ be continuous functions, representing liquidation and disclosure costs, associated with the bankruptcy process, with

$$Lq(w_0) = 0, \quad \frac{\partial Lq}{\partial w} > 0 \tag{6}$$

$$D(w_0) = 0, \quad \frac{\partial D}{\partial w} > 0 \tag{7}$$

Define $h(w) \in [0, 1]$ as the haircut awarded from the bankruptcy process with

$$h(w_0) = 1, \quad \lim_{w \to \infty} h(w) \to 0 \tag{8}$$

Defaulting without applying for bankruptcy, entails a cost $P < L$ summarizing the effect of the delinquency rate and other penalties, and offers expected benefits $B$, in terms of an expected, general haircut of size

$\alpha \in (0,1)$, which may be realized during the duration of the law with probability $p$. Penalties and level of political uncertainty are assumed to be exogenous.

$$B = \alpha \cdot p(unc) \cdot L = \hat{\alpha} \cdot L =, \quad where \quad \frac{\partial p}{\partial unc} > 0 \tag{9}$$

After the implementation of the law, the possible outcomes and their respective payoffs are as follows:

$$\textit{No Default}\text{: } V - L$$

$$\textit{Default and Apply}\text{: } V - L + h \cdot L - Lq - D \qquad \textit{Default and Not Apply}\text{: } V - L + B - P$$

**Proposition V.2** *For borrowers with low ability to pay, $A = \{w_A \leq w_L\}$, the strategy to "Default and Apply" is strictly preferable.*

**Proof** Using backwards induction, "Default and Apply" $\succeq$ "Default without Applying", if

$$V - L + h(w) \cdot L - Lq(w) - D(w) > V - L + B - P \xrightarrow{(6),(7),(8)} f(w) = h(w) \cdot L - Lq(w) - D(w) - B + P > 0$$

Assume that $Lq(\bar{w}) + D(\bar{w}) > h(\bar{w}) - \hat{\alpha} \cdot L + P$. $f(w)$ is continuous and decreasing in $w$, with $f(0) > 0$ and $f(\bar{w}) < 0$.

Therefore, from Bolzano theorem there is $w^* \in (0, w_H)$ for which $f(w^*) = 0$ and $\exists \epsilon > 0$ such that $f(w^* - \epsilon) > 0$ and $f(w^* + \epsilon) < 0$.

For borrowers with $w < w^*$, move to the upper node and consider the cases:

- Case 1: $B > P$, then "Default and Apply" $\succeq$ "No Default", for any $w < w^*$.
- Case 2: $B < P$, then define $g(w) = h(w) \cdot L - Lq(w) - D(w)$. $g(w)$ is continuous and decreasing $w$, with $g(0) > 0$ and $g(w^*) < 0$.

  Therefore, from Bolzano theorem there is $w^{**} \in (0, w^*$ for which $g(w^{**}) = 0$ and $\exists \delta > 0$ such that $f(w^{**} - \delta) > 0$ and $f(w^{**} + \delta) < 0$.

  Therefore, "Default and Apply" $\succeq$ "No Default", for any $w < w^{**}$. ∎

**Proposition V.3** *For borrowers with high ability to pay, $B = \{w_B > w_H\}$, the strategy to "Default and Apply" is never preferable. The optimal strategies are to "Default without Applying" or "No Default", depending on the sign of $B - P$.*

**Proof** From proof of Proposition V.2, it follows that for borrowers with $w > w^*$, $f(w) < 0$ and "Default without Applying" $\preceq$ "Default and Apply".

For borrowers with $w > w^*$, move to the upper node and consider the cases:

- Case 1: $B > P$, then "Default without Applying" $\succeq$ "No Default", for any $w > w^*$.
- Case 2: $B < P$, then "Default without Applying" $\preceq$ "No Default", for any $w > w^*$. ∎

# Appendix Tables

**Table A.I: Determinants of defaults and strategic defaults - Probit Model**
This table presents marginal effects of Probit model estimations. In Columns 1-2 (3-4), the dependent variable is an indicator variable that equals one in case of default (strategic default), and zero otherwise. Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Defaulter** | (3) **Str.Defaulter** | (4) **Str.Defaulter** |
|---|---|---|---|---|
| Credit Score | -0.0010*** | -0.0010*** | 0.0003*** | 0.0004*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Total Income | -0.0020*** | -0.0019*** | 0.0012*** | 0.0015*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CLTV | 0.3022*** | 0.2481*** | -0.2206*** | -0.2180*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Loan Amount (K) | 0.0000*** | 0.0000*** | 0.0000 | 0.0000** |
| | (0.000) | (0.000) | (0.146) | (0.049) |
| Interest Rate | | 0.0077*** | | 0.0080** |
| | | (0.001) | | (0.013) |
| Maturity (years) | | 0.0039*** | | -0.0003 |
| | | (0.000) | | (0.449) |
| Num. people involved | | 0.0140*** | | -0.0315*** |
| | | (0.001) | | (0.000) |
| Observations | 44006 | 44006 | 18047 | 18047 |
| Pseudo $R^2$ | 0.0640 | 0.0678 | 0.0168 | 0.0191 |

**Table A.II: Determinants of defaults and strategic defaults - Probit Model**
This table presents marginal effects of Probit model estimations. In Columns 1-2 (3-4), the dependent variable is an indicator variable that equals one in case of default (strategic default), and zero otherwise. Standard errors are clustered by zip code and p-values are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) **Defaulter** | (2) **Defaulter** | (3) **Str.Defaulter** | (4) **Str.Defaulter** |
|---|---|---|---|---|
| Credit Score | -0.0010*** | -0.0008*** | 0.0004*** | 0.0004*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Total Income | -0.0019*** | -0.0012*** | 0.0015*** | 0.0014*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CLTV | 0.2481*** | 0.2462*** | -0.2180*** | -0.2065*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Loan Amount (K) | 0.0000*** | 0.0000*** | 0.0000** | 0.0000 |
| | (0.000) | (0.000) | (0.049) | (0.464) |
| Interest Rate | 0.0077*** | 0.0064** | 0.0080** | 0.0077** |
| | (0.001) | (0.012) | (0.013) | (0.024) |
| Maturity (years) | 0.0039*** | 0.0040*** | -0.0003 | -0.0005 |
| | (0.000) | (0.000) | (0.449) | (0.345) |
| Num. people involved | 0.0140*** | -0.0019 | -0.0315*** | -0.0288*** |
| | (0.001) | (0.661) | (0.000) | (0.000) |
| College Education | | -0.1290*** | | 0.0161 |
| | | (0.000) | | (0.122) |
| Private Sector | | 0.0432*** | | 0.0027 |
| | | (0.000) | | (0.774) |
| Self-employed | | 0.0629*** | | 0.0768*** |
| | | (0.000) | | (0.000) |
| Pensioner | | -0.0074 | | -0.0673*** |
| | | (0.363) | | (0.000) |
| Single | | -0.0312*** | | 0.0006 |
| | | (0.000) | | (0.951) |
| Parent | | 0.0257*** | | 0.0140 |
| | | (0.000) | | (0.119) |
| Single-Parent | | 0.0697*** | | -0.0984*** |
| | | (0.000) | | (0.000) |
| Observations | 44006 | 39626 | 18047 | 15917 |
| Pseudo $R^2$ | 0.068 | 0.083 | 0.019 | 0.027 |